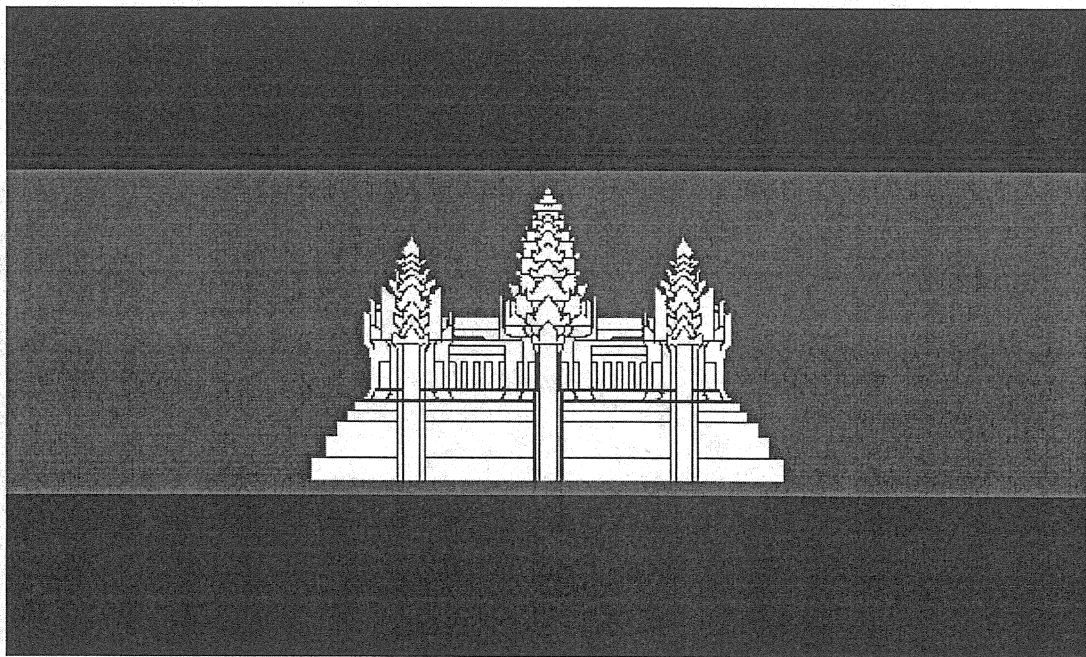


The Prevalence and Impact of Diabetes in Kep, Cambodia

April-May 2006



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This project was completed with equal participation of both authors in all stages of the project.

Abstract:

Aims: Primarily to discover the prevalence of high blood capillary glucose measurements diagnostic or indicative of Diabetes mellitus and to investigate the impact of Diabetes on the population of Kep, Cambodia. Secondly to discover which pharmaceuticals are available to the general population of Cambodia.

Method: Random capillary blood glucose sampling was undertaken in Kep referral hospital and the surrounding villages. Data collected included: age, sex, weight, blood glucose measurement and relevant symptoms associated with Diabetes.

Results: 236 people were tested, 17 results were discounted. 6.4% of the sample population had readings indicative of Diabetes. Of participants who had fasted 7.0% had impaired fasting glucose and of those who had not 7.3% had impaired glucose tolerance. Of the diabetic subjects 79% were female and 71% were aged between 45 and 64 years.

Discussion: This data shows that the proportion of people with Diabetes within the Cambodian population is higher than the WHO estimates for south-east Asia (2.7%), indicating that Diabetes is a more significant problem within Cambodia than originally believed.

Introduction:

“The magnificent temples of Angkor are unrivalled in the region and beyond the rich legacy of the Khmer empire lie the buzzing capital of Phnom Penh, hundreds of kilometres of unspoilt tropical beaches, the mighty Mekong River, a vibrant culture and some of the friendliest people”¹

Lured by the appeal of this beautiful yet poverty stricken Asian treasure, the authors chose to visit and carry out a project on Diabetes in an area where many of the population have never heard of the condition. Sadly the lack of knowledge regarding Diabetes does not equate with the lack of its existence there, yet little has ever been investigated in that area of the world.

Preahreacheanachakr Kampuchea: The Kingdom of Cambodia

Cambodia is a south-eastern Asian country, bordering the Gulf of Thailand, between Thailand, Vietnam, and Laos.



Cambodia has a total area of 181, 040 sq km, of which 176, 520 sq km is land. This country, approximately the size of France, has had a turbulent history which will briefly be discussed in the following paragraphs. The latter years are important in explaining why Cambodia is in the state it is today.

History:

Very little is known about prehistoric Cambodia. Indianisation of the country occurred around AD100, bringing with it religions, language, and sculpture. During the 6th century it developed to wet-rice agriculture with population concentrating around the country's two main rivers.

From the 9th to the 15th century the Khmer Empire extended far beyond the country's boundaries. This period produced the glorious temple complex and royal palace at Angkor, visited today by travelers from all over the world. The Khmer kingdom gradually declined. It accepted French protection in 1863 later becoming incorporated into French Indochina².

Cambodia became independent in 1953 under the reign of King Sihanouk. Norodom Sihanouk came to the throne in 1941 and made it his mission to gain independence from the French. He was and still remains one of the most prominent and popular figures within Cambodia, switching between royalty and government. In 1970, in the midst of the Vietnam War and the turmoil it inflicted on the country the National Assembly elected to remove Sihanouk from power and exiled him to Beijing.

Two weeks before the fall of Saigon in neighbouring Vietnam; on April 17th 1975, Cambodian Communists known as the Khmer Rouge took control of the country, which was renamed Democratic Kampuchea. They implemented one of the most radical and brutal restructurings of a society that has ever taken place. The

clocks were turned back to year zero, and the aims were to transform Cambodia into a Maoist, peasant-dominated, agricultural country.

The policies instituted led to the deaths of at least 1 million people. The populations of all cities were forced to march out into the countryside where everyone worked twelve to fifteen hours a day on the land. All the educated people were tortured and executed, as were those who disobeyed this regime.

The Khmer Rouge were eventually driven out in 1979 by the Vietnamese army and Cambodian exiles, and retreated to the depths of the northern forests, where it is believed that some may still be hiding today. 1980 saw a country gripped by famine, and, with their economy in tatters Cambodia remained closed to the western world for most of the eighties. In 1989 the Vietnamese removed their troops from Cambodia.

In 1991, the parties of the civil war signed an agreement with the aid of the UN to end the hostilities in Cambodia. The peace treaty, known as the Paris Peace Accords, gave the UN a large mandate to build peace in Cambodia. The UN was to lead Cambodia to democracy and peace by organizing free and fair democratic elections. In the elections that were held in 1993, more than 90 % of the Cambodians cast their votes. The pro-monarchy party (FUNCINPEC) that won the elections and the party that represented the previous regime (CPP) formed a coalition government³.

The relationship between the two parties was characterized by lack of trust: both of the main parties in the government had their own armed forces. It proved impossible to unite them into one national army. The tensions between the parties led to an armed conflict in the streets of Phnom Penh in July 1997. The CPP emerged as the stronger party, and its leader Hun Sen became the dominant figure in Cambodian politics.

Second national elections were held in 1998. The CPP won the elections. The same party was victorious also in the communal elections of 2002 and remain in power now. King Sihamoni is currently on the throne following the abdication of his father, Sihanouk, in October 2004. This is believed by many to have been a tactical decision to ensure the future of the monarchy.

Today this beautiful country still reels from its past. The past turmoil has led to Cambodia being set back at least one hundred years.

People:

The country is currently home to a population of 13,881,247 people with their life expectancy being 59. The ethnicity of the country is predominantly Khmer (90%). The remainder consists of 5% Vietnamese, 1% Chinese and 4% of other ethnic groups. The majority, approximately 95%, of the population are Buddhists; this has been the case since the Angkor era. The Cham population are Muslim and there is a growing Christian community in Cambodia.

Climate:

Cambodia has a classic tropical climate; it is cooler in the north-east, but even there it is rarely cold. Rains fall daily from June to September and average temperatures range from the high twenties to the high thirties and beyond.

Kep:

The district of Krong Kep is a small province located on the south-east coast of Cambodia. Kep was officially made a city during Cambodia's time as a French colony when Kep-sur-Mer was a popular seaside resort. However, during the Khmer Rouge Era most of the villas were burnt down or destroyed, leaving little more than skeletons¹. Kep district consists of 5 communes and 16 villages. The population is around 34,000 (2004) of which 13,000 are under 14 and only 1,300 are over 65. Approximately 1,500 families out of 6,800 have water by their homes with 3,500 using a common source of water (pond, river water or rain water). Most people live in houses with thatched or tin roofs and only 450 have a toilet in

their homes⁴. Kep is due to be linked to mains electricity by the end of 2006; at the present time generators are used for all power, but only by those that can afford to do so.

Kep has a number of health facilities. There are three health centres within the Kep district; Okrasa, Angkoul and Pong Tuek. These are government funded and provide a service from Monday to Friday. Their aim is education and clinical outreach, including vaccinations. They are staffed by nurses and assistants. On the whole they are underused and distrusted, however their outreach into the villages is very important for the Operation District to which they report each month (appendix 1).

There is a referral hospital within Kep. It is the only place within the region where there is a licensed, qualified medical doctor. It also has a wider range of treatments available than at the health centres. The pharmacy contains 85 items, of which the majority are vitamins and dressings. The hospital owns X-ray equipment and drugs for treating tuberculosis, which the government provides. The hospital has a delivery suite, a tuberculosis ward and a general medical ward. However there are very few inpatients as most patients prefer to stay at home and avoid the costs incurred by a hospital stay.



Kep referral hospital, 2006

Pharmacies also play an important role in Cambodian medicine, as it is here that most people consult first; they are more trusted than the health centres. However, most of these are unlicensed and would be better referred to as 'drug sellers' especially as the pharmacists often do not know the names of the drugs they are selling, only what they perceive they can be used for!

Private Doctors also exist in Cambodia; again most of these are unlicensed and have little training. They are however willing to travel to patients' homes and are therefore more popular with patients who find the distances to the health centres a problem.

The one remaining option in Kep for health advice and treatment is to consult a traditional healer (Kru Khmer). Some of these healers are spiritual, others are not. Some will only treat one condition, others are much more general. Most treatments use plant or herbal remedies because many plants are viewed as having healing properties⁵.

The ministry of health has granted permission to the University of Toronto to establish a Centre for International Health in Kep. The Centre staff work closely with the village elders, commune chiefs and Operational District in order to research health issues, undertake outreach and offer health education. The ultimate aim is to develop a healthcare system model that is effective and could be used elsewhere in Cambodia. The authors' research took place from this base.

Diabetes:

Diabetes Mellitus is a multi-system disorder of carbohydrate, fat and protein metabolism in which sugars in the body are not oxidised to produce energy due to a lack of insulin⁶. Type 1 Diabetes occurs mainly in children and is an autoimmune disorder leading to complete destruction of the islet cells in the pancreas, resulting in an insulin deficiency. Type 2 Diabetes occurs predominantly in later life and although insulin is present there is either not enough produced for the body's requirements or the cells are resistant to the insulin and thus leading to hyperglycaemia. Chronic hyperglycaemia has a number of complications, affecting different systems of the body. The most significant of these is the vascular complications as these are the commonest cause of death. There is a greatly increased chance of both myocardial infarction and stroke in diabetic patients. People may also suffer from diabetic retinopathy which causes a steady decline in the quality of one's vision. The kidneys may also be affected, causing nephropathy, and because the kidneys have a large reserve the problems of end stage renal failure does not present until the condition is established.

The WHO has set guidelines in order to help clinicians differentiate between normal, impaired glucose tolerance and Diabetes.

Table 1. Values for diagnosis of diabetes mellitus and other categories of hyperglycaemia

	Glucose concentration, mmol l ⁻¹ (mg dl ⁻¹)		
	Whole blood		Plasma*
	Venous	Capillary	Venous
Diabetes Mellitus:			
Fasting	≥ 6.1 (≥ 110)	≥ 6.1 (≥ 110)	≥ 7.0 (≥ 126)
or			
2-h post glucose load	≥ 10.0 (≥ 180)	≥ 11.1 (≥ 200)	≥ 11.1 (≥ 200)
or both			
Impaired Glucose Tolerance (IGT):			
Fasting (if measured)	< 6.1 (< 110)	< 6.1 (< 110)	< 7.0 (< 126)
and			
2-h post glucose load	≥ 6.7 (≥ 120) and < 10.0 (< 180)	≥ 7.8 (≥ 140) and < 11.1 (< 200)	≥ 7.8 (≥ 140) and < 11.1 (< 200)
Impaired Fasting Glycaemia (IFG):			
Fasting	≥ 5.6 (≥ 100) and < 6.1 (< 110)	≥ 5.6 (≥ 100) and < 6.1 (< 110)	≥ 6.1 (≥ 110) and < 7.0 (< 126)
and (if measured)			
2-h post glucose load	< 6.7 (< 120)	< 7.8 (< 140)	< 7.8 (< 140)

* Corresponding values for capillary plasma are: for Diabetes Mellitus, fasting ≥ 7.0 (≥ 126), 2-h ≥ 12.2 (≥ 220); for Impaired Glucose Tolerance, fasting < 7.0 (< 126) and 2-h ≥ 8.9 (≥ 160) and < 12.2 (< 220); and for Impaired Fasting Glycaemia ≥ 6.1 (≥ 110) and < 7.0 (< 126) and if measured, 2-h < 8.9 (< 160).

It is known that the increasing incidence of type 2 Diabetes is linked to western lifestyle and diet. Obesity is also known to be a factor in insulin resistance and therefore the development of Diabetes. The typical Cambodian diet on the whole would not naturally predispose to type 2 Diabetes. Cambodians' diet consists of rice porridge for breakfast, soup at lunchtime and rice or noodles with meat and vegetables in the evening, with very little variation to this pattern. Snacks consist of fruit or sugar cane juice, and are consumed in abundance, due to their easy availability.

It is known that Diabetes is a significant problem in Western Society. It is estimated that 1.9 million people in the UK have Diabetes with a cost to the NHS of 5 billion pounds per year. There is now increasing evidence that Diabetes may be a growing problem in less developed areas of the world. It is estimated that 76 percent of the total number of people with Diabetes worldwide are in developing countries. Although infectious diseases are the major killers at the moment the WHO estimates that non-communicable diseases, for example cardiovascular events or Diabetes, will become major disablers and killers within 25 years.⁷ A limited amount of research has been undertaken in Cambodia related to Diabetes, therefore in order to get a fuller picture of what may be happening it

has been necessary to look to other south-east Asian countries, especially Vietnam.

Literature Review:

The WHO estimated the prevalence of Diabetes in South East Asia in 2000 at 46,903,000 and estimates it will rise to 119,541,000 by 2025⁸. Wild et al also undertook a project to estimate the prevalence of Diabetes and to estimate what it may be in 2030; their data gave a percentage increase of 148% over the next 30 years⁹. Individual studies going back as far as 1989 highlighted a high prevalence of gestational Diabetes in Cambodian women, with a prevalence of 16.1%¹⁰. High rates have been found consistently throughout Vietnam with a 1.2% prevalence of Diabetes and 1.6% of impaired glucose tolerance in 1990¹¹, rising to 2.7% prevalence of Diabetes and 7.3% impaired glucose tolerance in 2002, according to the WHO and National Project of Diabetes prevention and management¹².

The most relevant survey to this study was undertaken in 2004 looking at two villages, one rural, one semi urban, in north-west Cambodia and two in east Cambodia, both semi-urban. The prevalence of Diabetes in north-west Cambodia was found to be 4.8% and impaired glucose tolerance 9.9%. In eastern Cambodia the prevalence was discovered to be 11.4% and impaired glucose tolerance was 15.2%. The author noted the range of differences between the urban and rural populations and also the different areas of the country¹³.

Several studies within Vietnam after noting the high prevalence of Diabetes have tried to investigate underlying reasons for this, especially as most of the patients were not obese. It has been hypothesised that the development of Diabetes could be better attributed to nutritional insults during development which may increase the chance of chronic disease⁶. Another study found that although body mass index was normal there were high levels of total body and abdominal fat.

This may be due to the 'nutritional transition' that developing countries go through when there is an increase in food consumption, especially animal fat and protein, along with decreased physical exercise¹⁴. Part of this may be due to the cultural element which indicates that the wealthier you are the larger you are, as being thin is a sign of poverty. People in South-east Asia may also be at an increased risk as it has been found that Vietnamese rice, which is a fairly staple food, has a high glycaemic index. Chronic ingestion of high glycaemic index foods has been shown to lead to wide fluctuations in post-prandial glucose and insulin¹⁵.

Aims and Objectives:

- To discover the prevalence of high blood capillary glucose measurements diagnostic or indicative of Diabetes Mellitus
- To investigate the impact of Diabetes on the people of Kep
- To discover which pharmaceuticals are available to the general population of Cambodia, including those used for Diabetes.

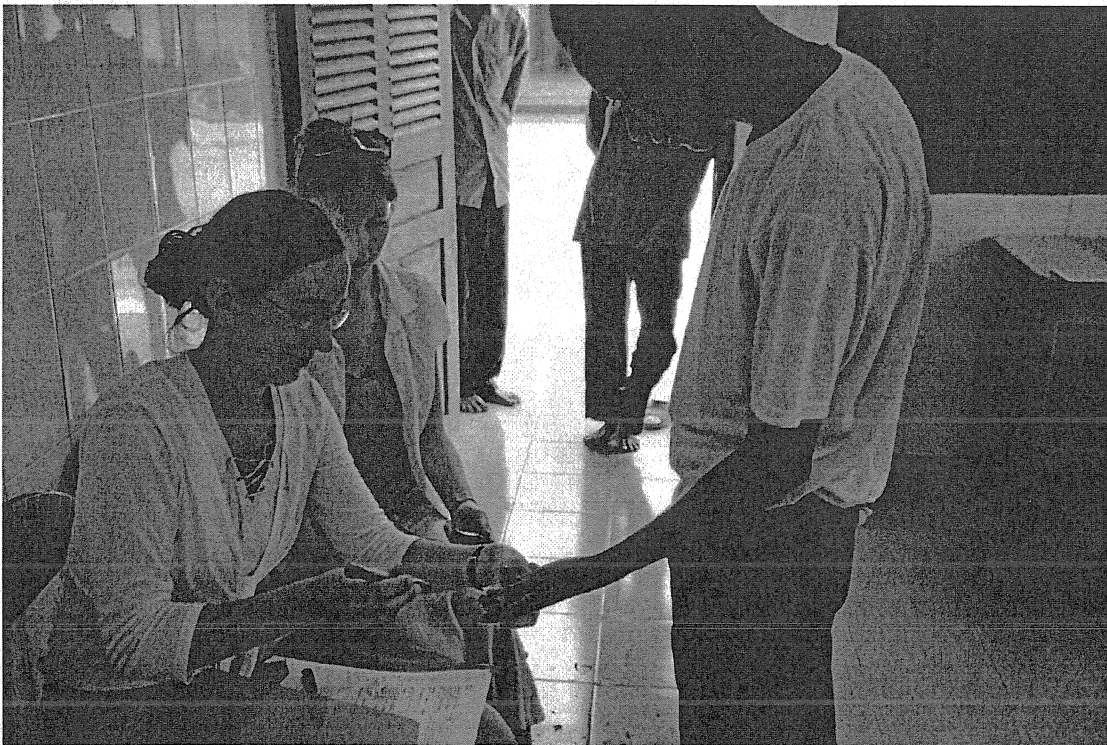
Method:

The authors knew that they wished to spend their research elective in Cambodia. Various potential placements were contacted via email and letters. The enthusiasm and opportunity to undertake worthwhile research was clearly apparent from the Centre of International Health based in Kep. With the placement confirmed the project details were finalised according to what would be of most benefit to the local population. TB, HIV and Malaria are well documented and researched problems in developing countries such as Cambodia. Other conditions like Diabetes and hypertension which pose a significant threat to health have not been well researched. The authors felt these would be beneficial to study, in order to raise awareness not only to the people of Cambodia but to those who may have the means to tackle this problem. The period of data collection was during April and May 2006. Prior to departure

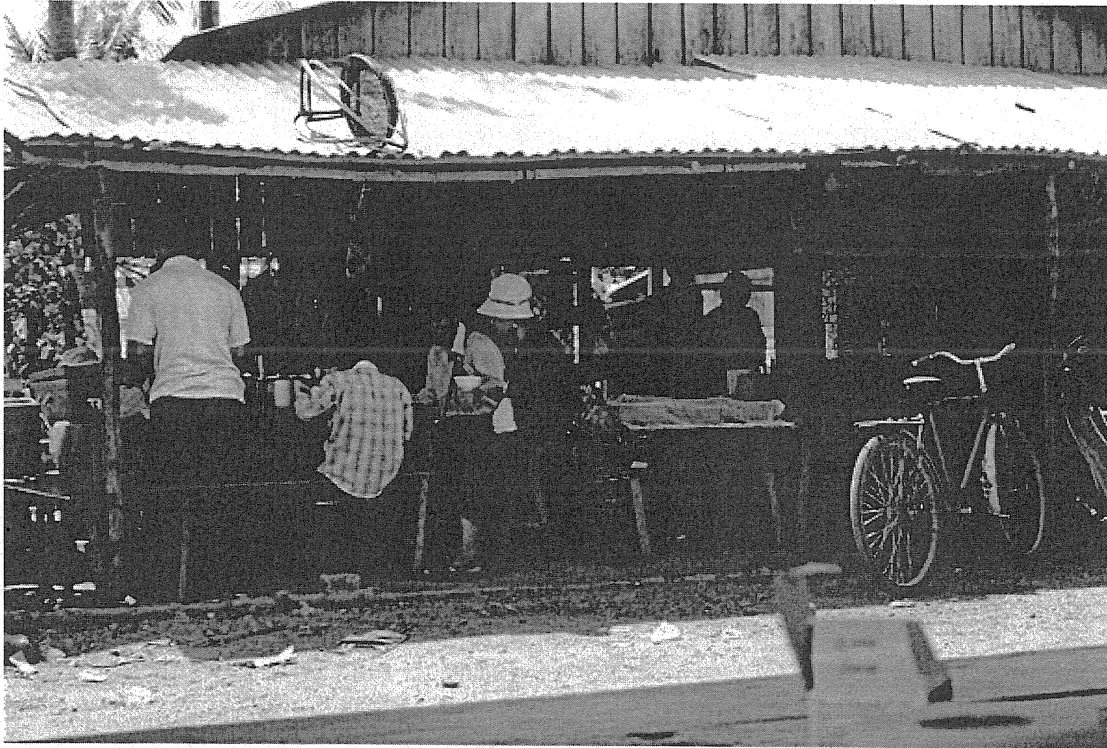
sponsorship and necessary equipment was obtained. LifeScan® OneTouch® Ultra® blood glucose monitoring system and lancets were used. Approval was sought from the Cambodian bioethical committee (appendix 1) as well as the hospital director and local village elders.

On arrival in Cambodia a meeting was arranged with the hospital director and doctors and the equipment was duly demonstrated. The proforma (appendix 2) was translated into Khmer. Local people had been invited by the hospital to attend for testing and education about Diabetes. Verbal consent was obtained from each participant by the translator and no-one who was unwilling participated.

Capillary blood glucose sampling was carried out in the outpatient area of the hospital:



Local village populations were also sampled, with permission from both the village elders and each individual.



Phnom Leav Village

Each participant was asked how long it was since they had eaten, the aim being that the majority of samples would be two hours post-prandial; however some people were fasting. Those who had eaten more recently were encouraged to return two hours after eating. Within the hospital setting weights were obtained, however this proved very difficult in the village setting. For those with a high blood sugar reading a simple questionnaire about symptoms was asked (appendix 2) and basic education about diet and lifestyle was given. Education fact-sheets were also prepared for the doctors and healthcare workers (appendix 3).

Data analysis:

Information was collated as follows:

- Age and sex
- Weight (where feasible)
- Location
- Capillary blood glucose measurement (repeated as necessary)

- If symptomatic, the symptoms experienced were recorded

Data were analysed to calculate the prevalence for the sample population and then extrapolated beyond to estimate the prevalence for the population of Kep. Data were also used to look at relationships between blood capillary glucose, age and sex. This was done to establish if there is a particular population that is at risk of developing Diabetes.

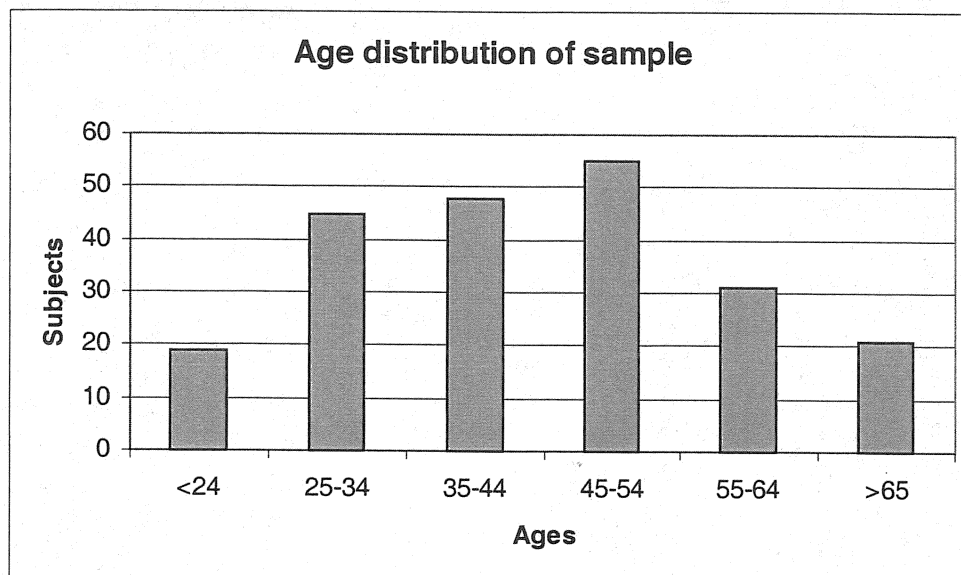
Data were analysed separately depending on whether the samples were fasting or post-prandial. Results were then categorised into the appropriate group according to the WHO guidelines as demonstrated in the introduction.

Although weights were recorded for all participants at Kep Referral Hospital without being able to accurately measure heights to calculate Body Mass Index this data has little relevance and therefore was not subsequently analysed.

Results:

236 people took part in the study of which 219 were suitable for analysis. 81 males and 138 females participated, 59% of the women and 62% of the men came from villages. The other 41% and 38% respectively came to Kep Referral Hospital (KRH) to be tested. 17 samples had to be discounted as they were taken less than 2 hours since food had been consumed.

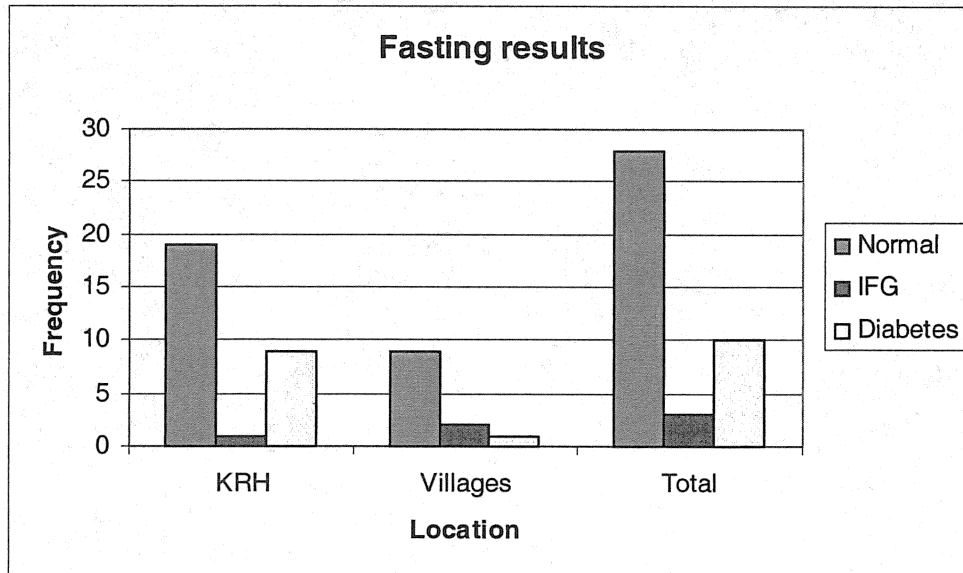
All participants were over the age of 20 in order to focus on adult onset Diabetes Mellitus. By focussing on adults we also avoided ethical issues involved with the participation of children. There were few participants over the age of 65, which corresponds to the demographics of Cambodian society.



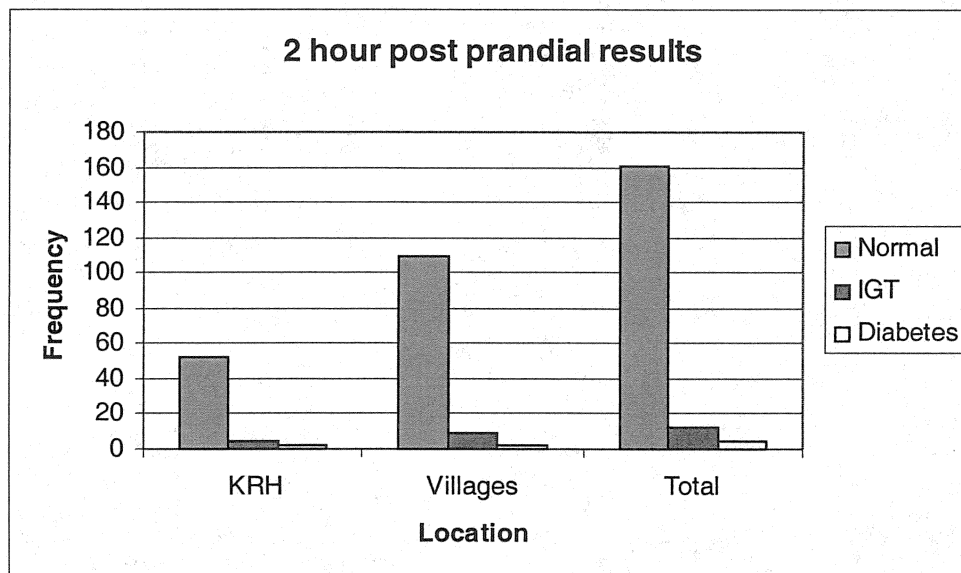
The samples were analysed separately depending on whether a fasting or 2 hour post-prandial reading was obtained. The WHO guidelines for diagnosis of Diabetes Mellitus and other forms of hyperglycaemia (see introduction) were used to separate the samples into categories.

Table of results

		KRH	Villages	Total
Fasting	Normal	19	9	28
	IFG	1	2	3
	Diabetes	9	1	10
2 hours	Normal	52	109	161
	IGT	4	9	13
	Diabetes	2	2	4

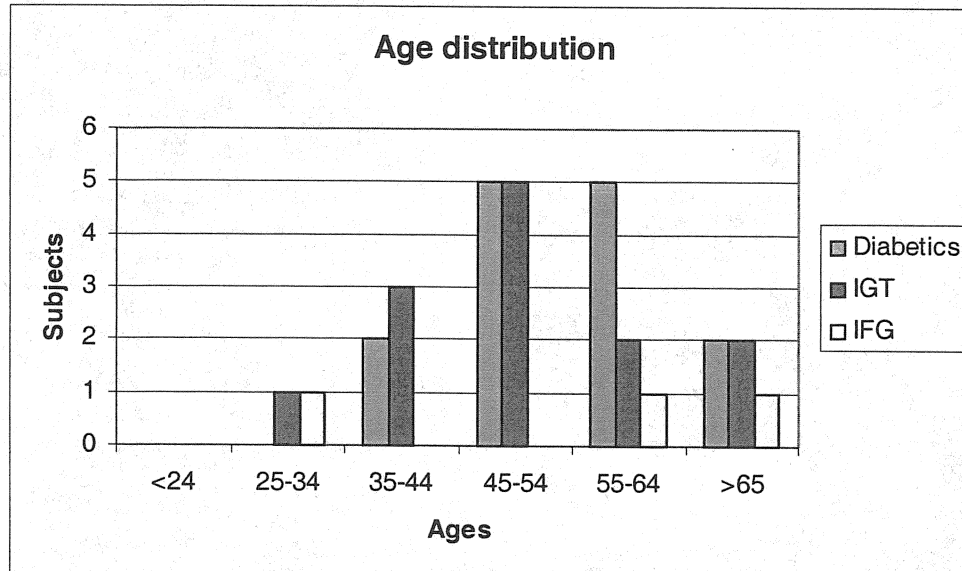


18% of the sample population were fasting, of which 24% were diabetic and 7% had impaired fasting glucose.

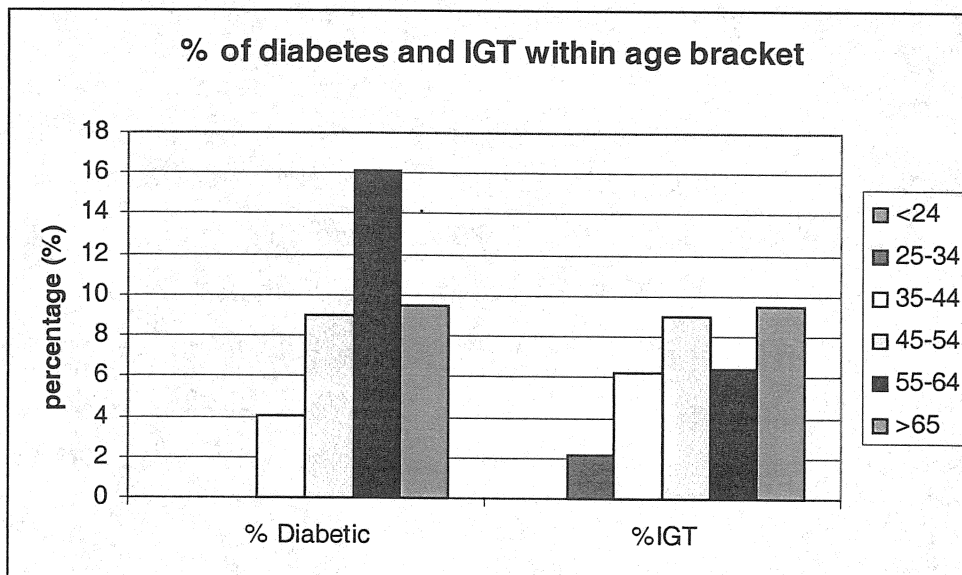


82% of the sample population were between 2 and 8 hours post prandial. 2% of the population were diabetic and 7.3% had impaired glucose tolerance.

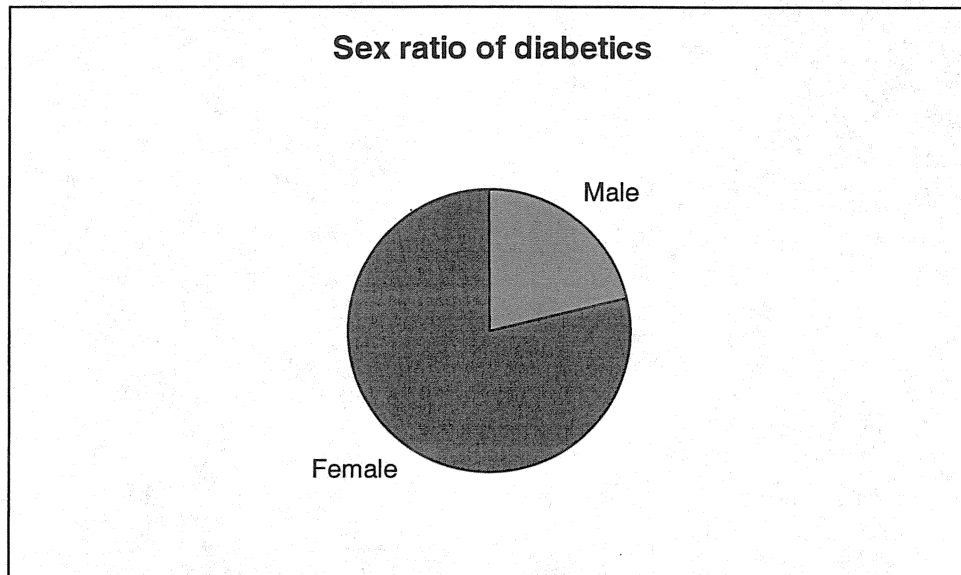
Therefore in total, fourteen participants of the 219 were diabetic, if this figure were to apply across the entire adult population of Kep district, 1340 (3sf) would be diabetic.



Of the population that had altered glycaemic levels there were no diabetics aged less than 35 years. The majority of those that were diabetics were within the age distribution of 45-64 years. Proportionally fewer people over the age of 65 had Diabetes which would be in keeping with the population size of this age range.



This graph clearly demonstrates that the 55-64 year old age bracket has the greatest percentage of Diabetic people within its population.



7.9% of the female population and 3.7% of the male sample population were diabetic.

Of the fourteen Diabetics who completed the symptoms questionnaire; nine complained of thirst, nine complained of fatigue, ten complained of polyuria/nocturia and one had had a stroke.

Discussion:

This data shows that the proportion of people with Diabetes within the Cambodian population is higher than the WHO estimate for south-east Asia, which is 2.7%. It is however in keeping with previous Cambodian Diabetes Mellitus studies⁷ indicating that perhaps it may not be possible to generalise Cambodia with other south-east Asian countries. This could be due to diet or lifestyle factors, or the turbulent times of their past. The WHO estimate for impaired glucose tolerance is in keeping with the results of this study as they estimate it at 7.3% and this study showed an identical value.

These results are likely to apply to other rural areas of Cambodia, as had been noted in previous literature. However it is unlikely to be applicable to urban areas, in particular the busy capital of Phnom Penh which is more susceptible to western influences with every year that passes.

The data also shows that the peak prevalence is within the 45-64 year age range which could either indicate that this generation is more susceptible to Diabetes Mellitus or because life expectancy is 59 years those that survive beyond this age are healthier.

Proportionally more females than males were diabetic, which is different to the distribution found in UK¹⁶. One factor known to be related to type 2 Diabetes is obesity. In Cambodia obesity itself is not noted to be a problem. Most people are agricultural workers or manual labourers, these occupations combined with their modest diet mean that people are less likely to become obese. The authors observed however that many of the wealthier 'Grandmothers' are overweight, which may be a contributing factor in their development of Diabetes.

For people who were hyperglycaemic symptoms were noted. Due to the vague nature of these symptoms it is impossible to determine if these were related to Diabetes, other disease or simply due to climate factors and therefore little valuable information can be drawn from them.

The most frustrating aspect of this study is that whilst it is possible to test people for Diabetes the means of treating the condition are not currently available in Cambodia. Treatment options ideally include both conservative advice and medical management. Medical management itself would consist of oral anti-diabetic drugs, for example metformin or gliclazide, and possibly insulin. Currently in Cambodia those who can afford it may purchase 80mg of gliclazide to be taken once daily. This is obviously not ideal as there is no monitoring in place and this dose is probably inadequate, however due to the hypoglycaemic

risks associated with sulphonylureas it would be inadvisable to experiment with larger dosages. Other options include herbal remedies and a remedy containing the plant *Cassia occidentalis* L. is believed by Cambodians to be effective in treating Diabetes, there is however no evidence base to prove this. There is also an element of faith and healing, thus leading to the feeling that medical treatment is unnecessary for Diabetes.

A final point to be aware of is that in a country where AIDS and motorbike accidents are such a common cause of death is it really fair to impose upon them another condition which although treatable is not curable, bearing in mind the limited resources that they have?

Limitations

Throughout the study the authors were reliant on translators to understand the level of knowledge the people had and any symptoms they may be experiencing. Translator error is always difficult to ascertain, the translators used had an excellent level of spoken English so hopefully this was minimised. Two different translators were used during the course of the study to maximise the number of participants that could be involved, however this again introduces error.

The lack of consistency from one person to another of the amount of food eaten and the duration since the last meal potentially made the results less reliable. In order to test impaired glucose tolerance in the UK a standard 75g bolus of glucose in 300ml of water is administered, and a blood test is carried out two hours afterwards. Limited funds, resources and time and the complications of trying to do this in a population with limited understanding of Diabetes Mellitus meant that this was beyond the scope of this study.

The protocol had stated that the authors would repeat samples on subjects whose readings were particularly high, however this proved to be very difficult due to a number of factors including the distances that people travelled to attend

the hospital, the widespread distribution of the villages and the authors desire to maintain anonymity for participants. Even though this is a limiting factor of the study in some cases the authors were able to overcome this difficulty, therefore hopefully reducing the error resulting from this.

In participants whose blood sugar levels were high a simple questionnaire was asked to try and gauge whether any symptoms were experienced. Symptoms that can be recognised include; thirst, polyuria and fatigue. However these symptoms are not necessarily experienced and in a hot climate they become even less accurate, as at 40°C and 100% humidity the most common complaints in Cambodia are thirst and fatigue, thereby showing how difficult it is for doctors to recognise Diabetes Mellitus in this setting.

The authors were unable to obtain past medical or social histories from participants as the setting that most of the tests took place in was unsuitable. The vast majority of the participants were not informed whether they have hypertension or cardiovascular disease and most of their treatments seemed to come from traditional healers. This makes obtaining a relevant history incredibly difficult.

During the study the authors also discovered the limited knowledge that the local people had regarding Diabetes. This made judging the impact of Diabetes on the local community very difficult as they made various associations to do with the disease, for example one lady attributed persistent belching to her Diabetes. There were also concerns and beliefs that Diabetes Mellitus was an infectious and therefore contagious disease which in a country rife with HIV is understandably a worrying issue.

The power of a study is proportional to the number of participants involved, this study was limited in numbers by resources, ideally a greater proportion of the local population would have been tested. This would include an equal ratio of

male and female participants. The male quotient was restricted due to the hours of which the sampling took place, primarily during the day when the men were out at work.

Recommendations:

Following this study it is evident that Diabetes Mellitus is present and problematic in Cambodia. Unfortunately due to the country's current political and economic state facilities for diagnosis and treatment through the present healthcare system are not adequate to cope with the demands that Diabetes Mellitus would impose upon it. Ideally the population should be educated about Diabetes Mellitus and the presenting symptoms, there would then need to be means within the healthcare system whereby accurate testing and diagnosis could be implemented. Following this it is essential that appropriate treatment and monitoring can be provided, both in terms of dietary advice and suitable medications.

Realistically this is not feasible at this current time; however, the first step of this process would be to educate healthcare workers and local people about Diabetes and to encourage lifestyle and dietary changes as appropriate. Due to the cost and availability of equipment required for diagnostic testing one could not expect this to be widely available. However in those where a diagnosis is expected based on clinical judgement but not proved, dietary advice would do no harm and may indeed be all that is required.

The authors were able to offer basic verbal guidance during the study and have followed this up with the provision of written information (appendix 3a and 3b), translated into Khmer. This however presents its own problems as a large percentage of the population is illiterate.

Further studies which would be beneficial to the people of Cambodia would essentially take this study on a larger scale. It would also be recommended to

record blood pressure, waist circumference and ideally to ensure that all participants were fasted prior to testing, as this gives a more accurate result. These would be beneficial because waist circumference is a known risk factor for developing type 2 Diabetes Mellitus and being hypertensive and diabetic is linked with a greatly increased risk of cardiovascular complications, as shown by the Framingham study¹⁷.

This study has exclusively focussed on type 2 Diabetes and therefore to gain a full picture of Diabetes in Cambodia it would be essential to carry out a study looking specifically at the prevalence and impact associated with type 1 Diabetes.

Conclusions:

The authors conclude that this study has provided vital awareness to the population of Kep of the importance of Diabetes and its significance to health. It has also added to mounting evidence that this is an issue which needs to be addressed throughout Cambodia. Cambodia is a fantastic country with some of the world's most amiable people; they should have the same right to healthcare and treatment as is expected in the developed world, it should be the duty of those who can, to offer help to those who need it.

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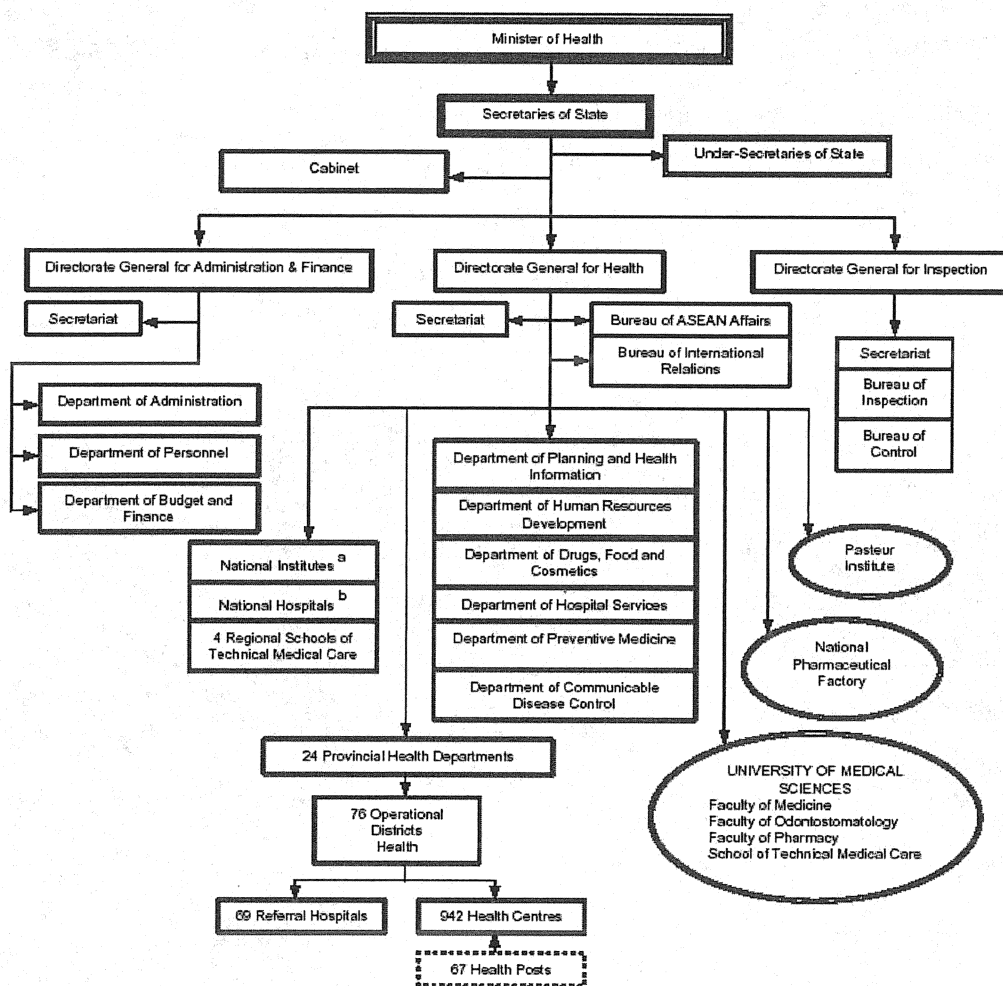
Novo Nordisk, Vandervell foundation and the Commonwealth Society for their financial assistance.

Dr John Milles for agreeing to supervise this project.

Appendix 1:

ORGANIZATIONAL CHART: MINISTRY OF HEALTH

ORGANIZATIONAL CHART OF THE MINISTRY OF HEALTH

**NE:**

^a NCHADS, NCTB/Lepr, NCMalaria, NCMCH, NIPH, NCTraMed, NCDrugQuaCon, NCBloodTran

^b Excluding Hospitals in NCMCH and NCTB/Lepr

^c Battambang, Kampot, Kg. Cham and Stung Treng

Appendix 2:

To whom it may concern:

there are two Birmingham Medical Students spending a month in Kep, Cambodia in April 2006. Attached is a protocol for a project we hope to be able to carry out, for which we are applying to you for bioethical approval.

A UK drug company has agreed to supply us with all the necessary equipment for this project, which it believes would be of great value.

Please let us know, via email preferably, if there is any additional information required for you to grant us this approval.

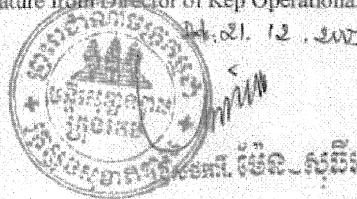
Many thanks; we look forward to hearing from you.

Yours sincerely,

Jenny & Rebecca

Jenny Stannard & Rebecca Taylor

approval signature from Director of Kep Operational District:



Appendix 3:

Proforma:

Age

Sex

Weight

Capillary blood glucose reading	
Time since food	
Capillary blood glucose reading	
Time since food	
Capillary blood glucose reading	
Time since food	

Symptoms

Thirst

Polyuria

Fatigue

Weight loss

Shortness of Breath

Ulcer

Other medical problems:

Appendix 4a:
Diabetes Factsheet for local people

What is Diabetes?

- You have a substance (insulin) in your body which breaks down sugar which you eat
- In Diabetes this goes wrong so you have too much sugar in your blood

What can happen?

- Excess sugar affects many parts of your body
- Eyes – lead to decreased vision and blindness
- Heart – can lead to heart attack
- Kidneys – stop working
- Strokes
- Loss of sensation in hands and feet

What can you do?

- Keep active and lose weight
- Eat a normal healthy diet but...
- Reduce sugar
 - Less/no sugar cane juice/ fizzy soda
 - Less/ no sweet fruit
 - Less/ no alcohol

Appendix 4b:

Diabetes Fact sheet for healthcare workers

What is Diabetes?

Diabetes is a lack of insulin, which is hormone produced by the pancreas. Insulin converts glucose to glucogen so when there is less of it the amount of sugar in the blood increases.

Why does it happen?

Associated with obesity (overweight), lack of exercise and too many calories.

How would you know someone was diabetic?

Blood glucose measurement:

Fasting – greater than 7mmol/l (126mg/dl)

2 hours after food – greater than 11.1mmol/l

Symptoms:

Thirst

Polyuria

Weight loss

What happens to people who are diabetic?

Vascular problems: heart attacks, strokes, peripheral vascular disease (gangrene)

Kidney problems: protein in the urine showing kidney damage

Eyes: retinopathy – leads to blindness

Neuropathy: loss of sensation in feet and hands

How can diabetic people be helped?

Need to:

- Exercise
- Lose weight
- Eat healthily
- Decrease sugar, fruit and alcohol intake
- Keep blood pressure low (<140/80mmHg)
- Stop smoking

If medicine is available:

Hypoglycaemics:

Metformin (0.5-1g three times a day)

Gliclazide (40-160mg once a day)

Decrease blood pressure (beta-blocker, ACE-inhibitor)

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